Cold Climate Housing NEWS

A Quarterly Newsletter For Building Professionals

Cold Climate Housing Center, Minnesota Extension Service
Minnesota Building Research Center, University of Minnesota

MnBRC Volume 4, Issue 1
Winter 1991

1991 WINTER WORKSHOPS

...Continue

During February and March, the CCHC staff will continue to conduct their annual series of educational programs for building professionals. This year's winter workshops emphasize **heating, cooling, ventilation,** and **retrofits,** but topics will vary by location.

Workshops have already been completed in Willmar, Mankato, Hennepin TC, Bemidji, Dakota TC, and Crookston. Listed below are the dates and locations for the remaining workshops:

February 19	Willmar
February 21	Detroit Lakes
February 25	Eveleth
February 26	Duluth
February 28	Rochester
March 1	Owatonna
March 5	Marshall

Schedule is subject to change.

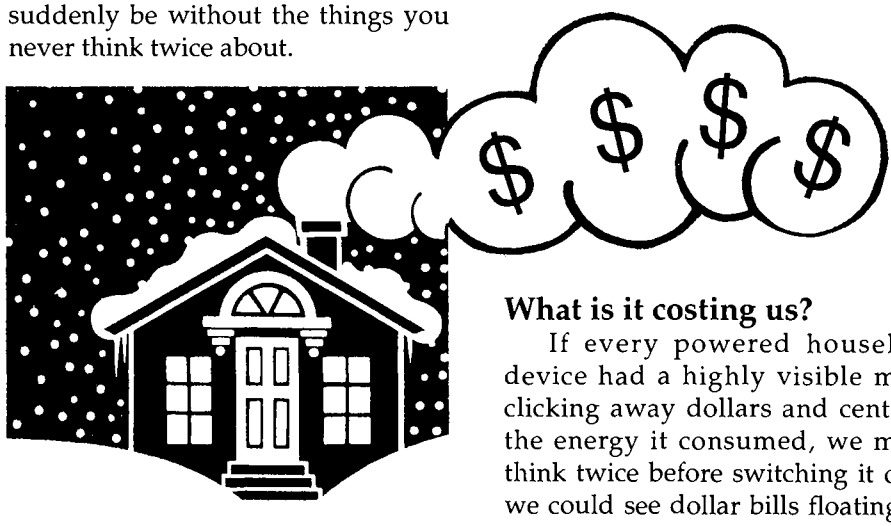
For more information, contact the CCHC at the number/address listed on page 3.

INSIDE THIS ISSUE

Residential Energy: What is it Costing Us?

Linda Yun, Forest Products

Most of us associate our homes with comfort, convenience, and security. We have come to expect certain things when we are at home. When we flip a switch, we expect a light, television, stereo, or other appliance to turn on. When we adjust the thermostat, we expect it to get warmer or cooler. Every time we take a shower, we expect there to be hot water. And we usually do all of these things (and more) without a second thought. Every day we rely on these things to operate for us, and usually they do. But if you've ever experienced a power outage or had your heating or cooling system break down, you know what it feels like to suddenly be without the things you never think twice about.



How much energy do we use?

The United States, although it accounts for only 5.2 percent of the world's population, uses more energy and resources and creates more pollution than any other country. In fact, it uses more than one-third of all the energy consumed in the world.

An average family spends more than one-fourth of their income for housing-related expenses. And residential energy consumption accounts for approximately one-fourth of all energy used in the U.S. In Minnesota, residential energy costs amounted to $1.74 billion in 1988, greater than two percent of the state gross product.

What's worse is that of all the energy used in American homes, more than half is wasted.

What is it costing us?

If every powered household device had a highly visible meter clicking away dollars and cents for the energy it consumed, we might think twice before switching it on. If we could see dollar bills floating out of leaky windows or walls, we'd undoubtedly act quickly. And what if we could somehow visualize the

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Residential Energy: What is it Costing Us?

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extra energy consumed by inefficient furnaces and poorly insulated walls and attics?

As "hidden" as some of these energy costs might seem, there are other costs even more elusive. The energy issue doesn't end with the effect it has on our checkbooks.

...of all the energy used in American homes, more than half is wasted.

Perhaps what is most difficult to calculate is the cost to our environment. In 1988, Minnesota's residential energy consumption resulted in approximately 47,000 tons of sulfur dioxide and 68,000 tons of nitrous oxide emissions which contribute to acid deposition. Additionally, more than 21 million tons of carbon dioxide, which may be contributing to global warming, were released into the atmosphere.

What we don't pay for now in our utility bills, we pay for later through the damage done to our environment and in the losses that result (see article below).

We also can't ignore the effect that energy consumption has on our economy. Minnesota exports nearly one billion dollars each year to pay its residential energy bills, producing a huge economic drain statewide. The United States imports half of the oil we use, worsening national economic conditions.

What can be done?

When it comes to residential energy conservation, a number of measures can be taken to reduce consumption and eliminate excess use. One of the simplest things that any one person can do is to modify their energy use habits. By just turning off unused lights or appliances, setting the thermostat back a few degrees, or not letting the hot water run excessively, you can not only add a few dollars to your pocket, but also reduce environmental costs.

Other energy-saving acts include installing storm windows; caulking leaks in ceilings, walls, and windows; adding attic, wall, or foundation insulation; providing regular furnace maintenance; and insulating your water heater.

Airtightening your home can be a big step toward reducing residential energy use. Residential moisture damage, which alone is said to cost Minnesotans nearly a billion dollars every year, could be prevented by airtightening as well as properly ventilating the home. Using energy-efficient heating systems and appliances also plays a major role in reducing energy use in the home.

The Cold Climate Housing Center promotes energy efficient practices in the design, construction, and operation of homes. For more information on what you can do to conserve energy in the home, contact the Center at the number and address listed on page 3. ■

Paying for Energy Through Our Environment

Bonnie Clark, Forest Products

Costs cannot always be measured in monetary units. Instead, scientific equipment may be needed or, in some cases, our own eyes can measure the cost. Our use of fossil fuels for energy and synthetic chemicals have caused environmental pollution in the form of acid rain and global warming. While the effects of acid rain are quite apparent and well understood by scientists, global warming is more difficult to identify. There is much debate among scientists over global warming; however, many agree that its effects may be extreme as well as potentially irreversible and, therefore, needs to be seriously studied.

Acid Rain

The burning of fossil fuels such as natural gas, petroleum, and coal is the main cause of acid rain. Emissions produced by the coal-burning industry and motor vehicles undergo a chemical reaction in the atmosphere and are changed into sulfuric and nitric acid particles. These particles eventually fall to the ground as dry particles or are washed from the atmosphere by some type of precipitation (see Figure 1). Emissions originating in one place can be carried by air currents and deposited in other regions of the country as well as in other parts of the world.

One effect of acid rain is increased acidity of soil and water. Soil eventually becomes so poor nothing will grow, and lakes and streams can also get to the point where they cannot sustain life. Today, some 9,000 U.S. lakes are threatened, and in one area, the Adirondacks in upstate New York, 212 lakes are now devoid of fish due to acid rain[1]. Northeastern Minnesota lakes are particularly susceptible to acid rain because they do not have the ability to neutralize acid.

[1]Minnesota Options for the 1990's. November, 1989. *The State Energy Policy and Conservation Report to the Legislature* (Draft). Minnesota Department of Public Service Energy Division.

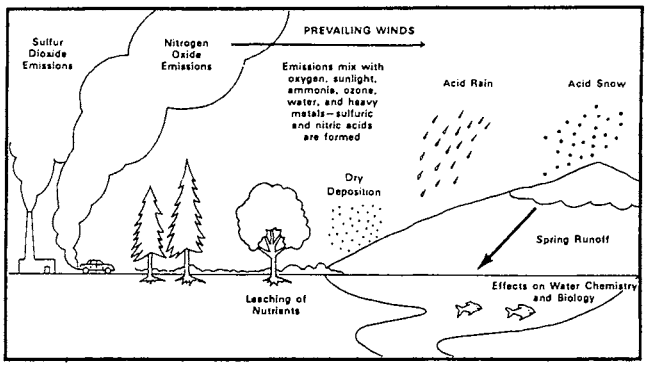

Figure 1. Emissions from coal burning industries and motor vehicles are converted into sulfuric and nitric acid particles which fall to the earth. During the winter, acids accumulate in snow; when the snow melts in the spring, the runoff has a concentrated acidity which can reduce the alkalinity of some lakes and streams.
Source: The Acid Rain Foundation, Inc. 1989. *Acid Rain in Minnesota.*

Global Warming

An increase in the earth's temperature is caused by (1) the "greenhouse effect" and (2) depletion of the ozone layer. The first of these, the greenhouse effect, occurs naturally. In fact, without the greenhouse effect, our planet would be cold and uninhabitable. Our planet functions like a "greenhouse" in that certain gases act like the glass in a greenhouse. They allow heat to pass through, but when the heat is reradiated from the earth, these "greenhouse gases" trap it.

The problem with the greenhouse effect is that there has been a buildup of greenhouse gases in the atmosphere largely due to the byproducts of our lifestyle. Scientists fear that these additional gases will cause an increase in temperature. Some gases are synthetic, such as chlorofluorocarbons (CFCs) formerly found in aerosols and still found in refrigerants. Others occur naturally but would not exist in such large quantities if it were not for human activities.

One of the major greenhouse gases is carbon dioxide, CO_2.

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CCHC: Providing Information for Energy-efficient Housing

The Cold Climate Housing Center (CCHC) provides information on energy-efficient housing design, construction, and operating practices which assure affordable, durable, comfortable, and healthy living environments for its owners and occupants. Staffed by a wide range of housing and building specialists, the CCHC offers numerous programs and services to meet a variety of needs.

The annual Winter Workshops for builders are offered statewide and address a number of energy-efficient practices. (See page 1 for the schedule of the 1990 Winter Workshops currently being held.) Each year the CCHC also offers a week-long summer school program for educators in the building trades.

In addition, the Center offers a series of 21 different publications which address topics ranging from indoor air quality to insulation and heating. (See page 8 for a complete list and order form.) For a broader source of information, the CCHC also maintains a reference database of literature pertaining to cold climate housing. To have a search on a particular topic conducted free of charge, simply contact the Center.

In the future, the CCHC will also be offering a series of thirteen video-tapes on topics ranging from general interest and awareness to how-to construction.

Specialists are on staff to answer calls as well as respond to written requests for information. If you have questions related to energy efficiency in housing, call or write the CCHC at the number and address listed on this page.

The Cold Climate Housing Center (CCHC)

is an interdisciplinary group that draws its technical expertise from three departments at the University of Minnesota: **Agricultural Engineering; Design, Housing, and Apparel;** and **Forest Products.** Throughout the year, the CCHC staff will be conducting educational programs in many subject areas related to cold climate housing. Questions regarding these programs and other information that is available through the Center can be directed to CCHC's central telephone number: **(612) 624-9219**. Technical questions will be forwarded to one of our specialists in the appropriate subject area.

Cold Climate Housing News is a publication of the Minnesota Extension Service. All requests to reprint or abstract any portion of this newsletter must be submitted in writing to the Cold Climate Housing Center.

If you have questions or comments regarding this newsletter, contact:

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Are you moving or receiving duplicate mailings? Please send your name and address, or any corrections, to the address above.
Thank you.

The House Doctor

The intent of this column is to discuss issues or problems currently being encountered by contractors, builders and consumers in building and maintaining homes in cold climate regions.

Home Indoor Air Investigations: A Method to the Madness

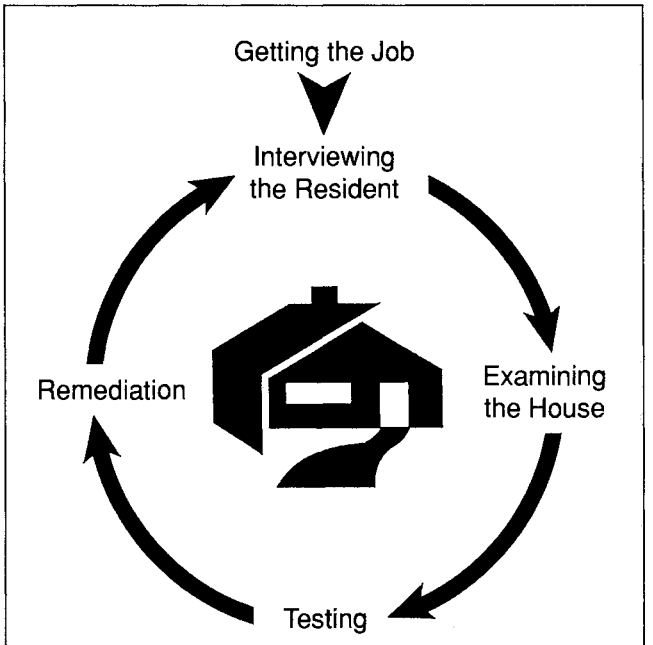
Sylvia Fuoss, *Design, Housing, and Apparel*

You need to begin and end an indoor air puzzle with people, but in the middle of the puzzle, it may seem like you are going in circles. An you may be! Solving indoor air quality (IAQ) problems often requires identifying and solving layer upon layer of problems. Eventually a core problem may be found and fixed.

Getting the Job

The first piece of the puzzle involves locating where the money is. The person in the family who controls the finances needs to believe they will get something out of your investigation, or you will not get the job. Or you will not get paid for what you have done. This does not mean you adjust your honest assessment of what needs to be done to make sure you get the job. It does mean you take care in how, when, and to whom you present your work proposal.

In doing the job your main objective will be to identify the pollutant and its source, and, if at all possible, to remove that source. If the source cannot be completely removed, steps should be taken to reduce emissions from the source to below the level expected to cause problems. This should be done by (1) isolating the source from the indoor air (encapsulating asbestos covering a pipe, for instance); (2) modifying the source or (3) filtering the emissions; or (4) reducing the load by dilution through ventilation with clean air.



Coming full circle in home indoor air investigations.

Interviewing the Resident

The second piece of the puzzle is begun by interviewing the resident. You want to find out what problem the resident perceives. The most important thing is to LISTEN. Use a short checklist of the important items you want to cover so that you don't waste time or loose track of your general order of questioning. **Who**, **what**, **when**, and **where** are your headings. Who is bothered (don't forget pets)? What is the effect? When did it start (that is, was it related to a new product, hobby, season, or time of the year)? When is it worst, or least, noticeable? Is it influenced by wind, rain, heat, etc.? Where in the home are these effects worst, or least noticeable? Were changes made in the house just before the problems were recognized? Ask for permission to tape record the interview. You'll be surprised at how much information a replay of the tape will yield.

Examining the Home

Now you're ready to examine the home. Your first action inside the unit should be to draw a careful and contemplative breath of air. You'll soon learn the characteristic odors of some common problems. There are important ones, however, that have no odor.

Here are some things to look for:

- combustion appliance malfunction, evidence of gas leaks, or improper use of the appliance (such as use of a gas oven for supplemental heating of a space;
- lack of exhaust ventilation for kitchen, bath, etc.;
- evidence of ongoing moisture damage to walls, windows, or flooring;
- evidence of standing water;
- visible mold or slime on surfaces, in

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Seeing is Believing: Demonstration Model Visualizes Airflows

Teddi Barron, Forest Products

Even the best teacher sometimes has trouble explaining unseen phenomena. Invisible subjects such as backdrafting, depressurization, moisture movement, and radon entry are tough to accept on faith alone. To help CCHC specialists and other housing educators describe airflows and airflow patterns in houses, a demonstration model has been developed and built by Joe Zulovich and John Fick of Agricultural Engineering. The Home Indoor Airflow Demonstration Model visualizes air movement under various house conditions.

The model consists of two parts. A plexiglass-faced display box contains a replica of a two-story house cross section. Inside are scaled-down models of a furnace, water heater, clothes dryer, fireplace, kitchen range hood, stairway, heat registers, bathroom shower, and recessed ceiling light. The second component of the model is a control box which includes operational equipment such as variable-speed fans and an air pump.

The air pump is used to push smoke through hoses to various ports on the back of the display box. With the fans at different settings, a variety of airflows can be visually illustrated inside the sealed display box. "The variable-speed fans create the needed pressure differentials for moving air throughout the house and for showing the interaction of various appliances in the house," Zulovich explained.

For example, to show the effects of inadequate makeup air for atmospheric combustion appliances, smoke can be seen pouring out of the fireplace opening when the range hood is turned on. In another demonstration, the importance of proper exhaust fan location is clearly

Joe Zulovich (above) and John Fick designed the airflow demonstration model, shown here without the plexiglass face. The model stands approximately 34" wide, 36" tall, and 6" deep, and weighs approximately 90 pounds.

To demonstrate backdrafting (left), smoke pours out of the fireplace when a negative house pressure is created by a kitchen fan in the model (shown here without plexiglass face). The model can also be used to demonstrate situations such as moisture accumulation in the bathroom as well as radon and soil gas entry in the basement. Variable speed fans create the pressure differentials for air movement throughout the house.

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Seeing Is Believing: Demonstration Model Visualizes Airflows

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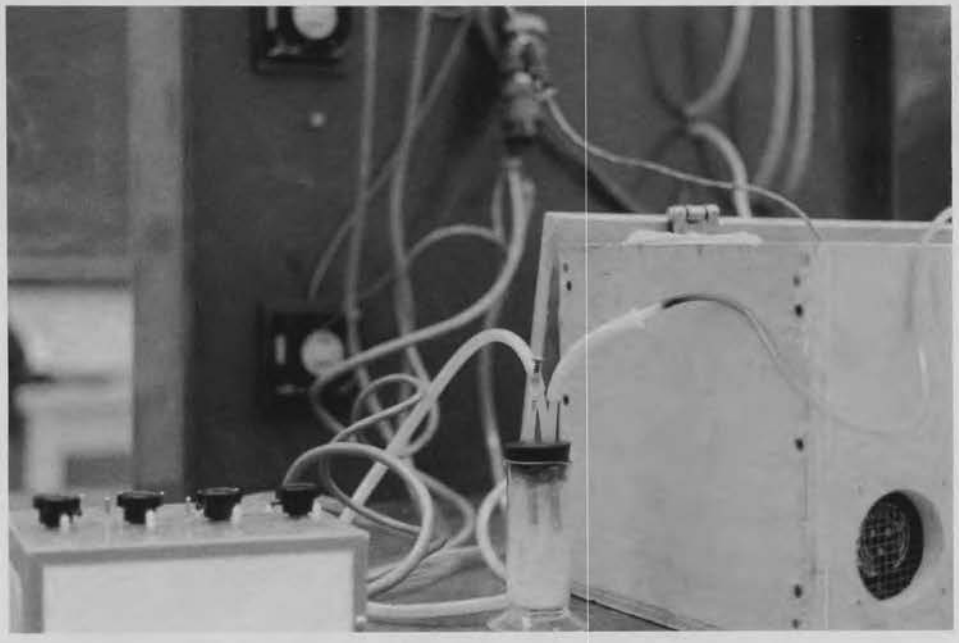

The operational equipment for the airflow model (switch box, smoke source, and control box containing air pumps) is connected to the back of the model with plastic tubing and various fixtures.

evident when smoke is used to represent moisture accumulation in the bathroom. And when the "model house" is depressurized, radon and soil gas entry is revealed as the smoke is drawn into the basement through cracks and openings.

Zulovich and Fick think the new teaching tool is a valuable addition to the Center's workshops for homeowners and homebuilders. "People have a hard time understanding airflow patterns in houses. When they actually see the smoke moving during different situations, airflows become tangible and much easier to comprehend," Zulovich said.

Housing educators and others interested in the demonstration model can purchase construction and operation plans or a complete working model soon. The University of Minnesota is copyrighting the model and plans are being developed. The complete plans will sell for $250 and the working model with instructions will be sold for $2,000. For more information, contact Joe Zulovich, University of Minnesota, 310 Agricultural Engineering, 1390 Eckles Avenue, St. Paul, Minnesota 55108; phone (612) 625-3701. ■

Backdrafting:

A situation in which exhaust fumes are not released to the outside due to a reverse in the flow of gases in the chimney or flue.

Home Indoor Air Investigations

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humidifiers, air conditioners, filters, etc.;
- location of fresh air intakes in relation to pollution sources;
- dry or hidden drains, or plugged vent stacks, gurgling plumbing, etc.;
- bugs, pests, and other critters, such as pets;
- anything "grossly smelly" such as carpet and/or pad, furniture, etc.;
- unsafe storage of pesticide, paint and cleaning products, or evidence of misuse;
- hobbies involving paints, solvents, or dust; and
- positive, negative, or intermittent fluctuations of the indoor/outdoor building air pressure.

Testing: When, Why and How

In the initial stages of the investigation, you can do some tests with relatively simple devices that change color to register a problematic amount of a chemical, such as the quiet killer, carbon monoxide. You can properly place passive monitors for measurement of formaldehyde or radon. It is helpful to know the level of hydrogen sulfide and carbon dioxide. Hydrogen sulfide can indicate a sewer gas problem. Carbon dioxide is a product of metabolism so it can indicate decay of an organic compound, or it may also come from inadequate ventilation of a gas kitchen range. You can purchase devices to sample these chemicals and have the sample analyzed at a safety supply company. Ask for technical assistance to obtain the most appropriate collection medium for the pollutant to be measured.

Professional tests must be done if it is necessary to establish both the presence of a pollutant and its concentration. These independent tests are invaluable when you need

to convince a client that the problem is such that resident health and safety demands remedial action. To determine the presence and clear identification of biologicals, such as molds, bacteria, or other living matter, you will require the collection and identification expertise of the professional. For litigation cases, a certified industrial hygienist should be hired to collect or supervise the collection of the samples, as they are more credible expert witnesses.

Professional testing can also be done to verify your suspicions. But if, in your initial investigation, you identify areas that need work, it is usually cheaper to do that work and note its effect, before you commission professional air testing. Tests for panels of volatile organic compounds (VOCs), for example, can run around $500 for a single sampling; and analysis of a single volatile organic substance can run $100 to $200. Professionals will also probably bill for mileage. In homes, the best results are achieved when VOC samplers are in place at least 24 hours and the level of detection is in the part per billion range.

The most complex problems are those that involve a possible external source, such as a soil gas. For instance, fumes from a leaking gasoline storage tank can move long distances through loose or cracked soil, or along a sewer or water pipe, before it enters the house. It is wise to look over official maps and plats of the area to locate potential exterior pollution sources such as landfills, industrial sites, etc., when elimination of indoor sources does not correct the problem.

Limitations of Public Officials

While government officials can be sympathetic, don't expect them to provide much help to the private homeowner. They are usually overworked and their projects underfunded. Their charge is to protect the health and safety of groups of people, so they cannot provide service to enhance the value of just a single home. They can be expected to fulfill their regulatory powers where it is applicable. For instance, a suspected gasoline leak or pesticide spill can be expected to be dealt with promptly. To expedite the process, learn what agency has oversight in the specific problem, gather your evidence in concise and orderly fashion, and present your case with a positive attitude and pleasant demeanor. Not even the most dedicated official wants to work with a grouch or a whiner.

Remediation

Some problems you can remediate yourself, you may subcontract a service, or the homeowner may prefer to have an independent contractor. If you do not do the work yourself, you should monitor the work to be sure your recommendations are adequately carried out.

For best results, remove the source to reduce pollutant emissions. Sometimes conditions that lead to the failure must be corrected. For instance, rotten wood must be removed, and an area around the rotten wood should be removed, too, because spread of the mold body is usually wider than the observable area. Then, to prevent mold regrowth in that area, the moisture level must be reduced.

Sometimes the source is something you can't remove. In those cases, try to encapsulate or modify the source, filter out the pollutant, or dilute it with fresh air so that the level of pollution can be expected to be acceptable.

Coming Full Circle

When you believe the work is finished, return to the occupants and solicit a response from them about the results. Ask each person simple, direct questions, one issue at a time. Include some time for the resident to give answers to questions you did not present. If you have not completely satisfied their needs in the problem, you may have to go 'round to start the identification and remediation process all over again. Do not consider this as a failure on your part. It is part of the process. Remember, the occupants must be judge of when the investigative process is completed.

In this business you can go 'round and 'round and back to the beginning many times. IAQ investigation can be complex, troubling, and sometimes downright maddening. But, done well, they can save a life, or they can make that life bearable. You can make the difference! ■

Paying for Energy Through Our Environment

Continued from page 3.

Deforestation and the burning of fossil fuels for energy all release huge amounts of CO_2 into the atmosphere. Carbon dioxide is a particular concern to scientists because they have found there is a direct correlation between an increased amount of CO_2 and an increase in temperatures. In fact, scientists believe that CO_2 accounts for 50 percent of the warming trend.

Depletion of the ozone layer also contributes to global warming. Ozone surrounds the earth and is the only substance that protects the earth from the sun's ultraviolet rays. Ozone is attacked by some synthetic chemicals such as CFCs. Specifically, the chlorine atoms in the CFCs are released and attack the ozone molecules; one chlorine atom destroys 100,000 ozone molecules.

The use of fossil fuels and the production of certain chemicals like CFCs have increased the cost of our consumption of these products because of their adverse impact on the environment. As consumers, we must make decisions based on awareness of how our lifestyle can effect our environment. ■

Cold Climate Housing Publications Order Form

Item Number	Title	Qty.	Price Each	Total
Indoor Air Quality				
CD-FO-3398-D	Home Indoor Air Quality Assessment		1.50	
HE-FO-3532-D	Radon Issues in House Buying and Selling		1.50	
HE-FS-3533-A	Radon Facts for House Buyers and Sellers		.25	
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HE-FS-3882-A	Minnesota Radon Facts		.25	
NR-FO-3887-C	Carbon Monoxide Concerns in Cold Climate Houses		1.00	
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CD-FO-3397-C	Mold and Mildew in the Home		1.00	
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CD-FO-3405-D	Moisture Sources/Potential Damage in CCH		1.50	
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CD-FO-3566-C	A Systems Approach to Cold Climate Housing		1.00	
			SUBTOTAL	
			MN Residents, Please include 6% Sales Tax	
			GRAND TOTAL	

Also available are two video tapes on range exhaust systems (call the CCHC for more information on obtaining these):

HE-VH-3593 "Performance of Kitchen Range Exhaust Systems"

HE-VH-3594 "Kitchen Range Exhaust Systems"

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